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SUISUN MARSH MONITORING PROGRAM ANNUAL DATA SUMMARY

WATER YEAR 2000

Submitted In Fulfillment of:

Suisun Marsh Preservation Agreement

Suisun Marsh Monitoring Agreement

San Francisco Bay Conservation and Development Commission
Permit No. 35-78 (M) and 4-84 (M)

U.S. Army Corps of Engineers Permit No. 16223E58,
Special Condition 1

September 2002

CALIFORNIA DEPARTMENT OF WATER RESOURCES

ENVIRONMENTAL SERVICES OFFICE

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Introduction

This report summarizes data collected in the Suisun Marsh during Water Year 2000 (October 1, 1999 through September 30, 2000) pursuant to the following agreements, permits, and water rights decisions:

- State Water Resources Control Board Decision1641, December 1999(SWRCB 1999);
- State Water Resources Control Board Order WR 2000-02, March 2000 (SWRCB 2000);
- Suisun Marsh Preservation Agreement, 1987 (USBR and others 1987);
- Suisun Marsh Monitoring Agreement, 1987 (DWR and others 1987);
- San Francisco Bay Conservation and Development Commission Permit No. 35-78 (M) Amendment 7, 1997 (for construction of the initial facilities, namely the Roaring River Distribution System, Morrow Island Distribution System, and Goodyear Slough Outfall) (BCDC 1997);
- San Francisco Bay Conservation and Development Commission Permit No. 4-84 (M) Amendment 4, 1991 (for construction of the Suisun Marsh Salinity Control Gates) (1991); and,
- U.S. Army Corps of Engineers Permit No. 16223E58 (for construction of the Suisun Marsh Salinity Control Gates), Special Condition 1, 1986 (USACE 1986).

This report fulfills a portion of the annual reporting requirements of the above-listed , agreements, permits, and water rights decisions as detailed in Table 1. Remaining reporting requirements will be fulfilled in other Department of Water Resources (DWR) and/or University of California, Davis reports.

DWR and the California Department of Fish and Game (DFG) primarily collected data summarized in this report. The data include:

- general hydrologic data;
- continuous channel water specific conductance and tidal height measurements;
- marsh-wide vegetation survey update;
- waterfowl abundance; and
- salt marsh harvest mouse occurrence.

Table 1- Suisun Marsh Reporting Requirements Covered in Department of Water Resources and/or University of California Davis Reports.

Reporting Information	Permit/Agreement Requiring Information[b]	SMMP[a] Data Summary Reports	Other DWR and/or UC Davis Reports
Monthly Mean High Tide Salinity	SWRCB, SMMA	x	
SMHM Surveys	USFWS BO	x	
Triennial Vegetation Surveys[c]	SMMA	x	
Waterfowl Population Surveys	SMMA	x	
Routine Maintenance Performed[d]	BCDC	x	
Maintenance Scheduled for Next Year[d]	BCDC	x	
UC Davis Fish Sampling	SWRCB[e], SMMA, USACE, BCDC		x
Larval Fish Survey	Not required[f]		x
Striped Bass Tow-Net Survey	SMMA, USACE, BCDC		x
Phytoplankton and *Neomysis* Surveys	SMMA, BCDC		x
Striped Bass Egg and Larva Survey	SMMA, USACE, BCDC		x
Juvenile Chinook Salmon Monitoring	SMMA, USACE, BCDC, NMFS		x
Predator Sampling	SMMA, USACE, BCDC, NMFS		x
Adult Salmon Migration Study	SMMA, USACE, BCDC, NMFS		x
Water Quality Profiling Program	SWRCB[e]		x

a = Suisun Marsh Monitoring Program
b = SWRCB: State Water Resources Control Board D-1641
SMMA: Suisun Marsh Monitoring Agreement (DWR and others 1987)
USFWS BO: U.S. Fish and Wildlife Service Biological Opinion 1-1-81-F-131
BCDC: San Francisco Bay Conservation and Development Commission Permits 35-78(m) and 4-84(m).
USACE: U.S. Army Corps of Engineers Permit 16223E58
NMFS: National Marine Fisheries Service 1993 Biological Opinion for Operation of the Federal Central Valley Project and the CA State Water Project
c = Surveys are conducted and results reported every three years.
d = Covers DWR facilities in Suisun Marsh such as the water quality monitoring stations and the initial facilities.
e = Falls under D-1485, and subsequently D-1641, requirement to conduct special studies to develop a better understanding of thehydrodynamics, water quality, productivity and significant ecological interactions of the Marsh.
f = The larval fish study is not required by any DWR permits. Data from this study provides a more complete picture of the Suisun Marsh fishery and provides additional information to help guide CEQA and ESA compliance for DWR projects .

Background

The Suisun Marsh is located about 35 miles northeast of San Francisco in southern Solano County (Figure 1). The Suisun Marsh is one of the largest brackish water marshes in the United States. It provides habitat for numerous species of plants, fish, and wildlife and is a critical component of the San Francisco Bay/Sacramento San-Joaquin Delta estuary.

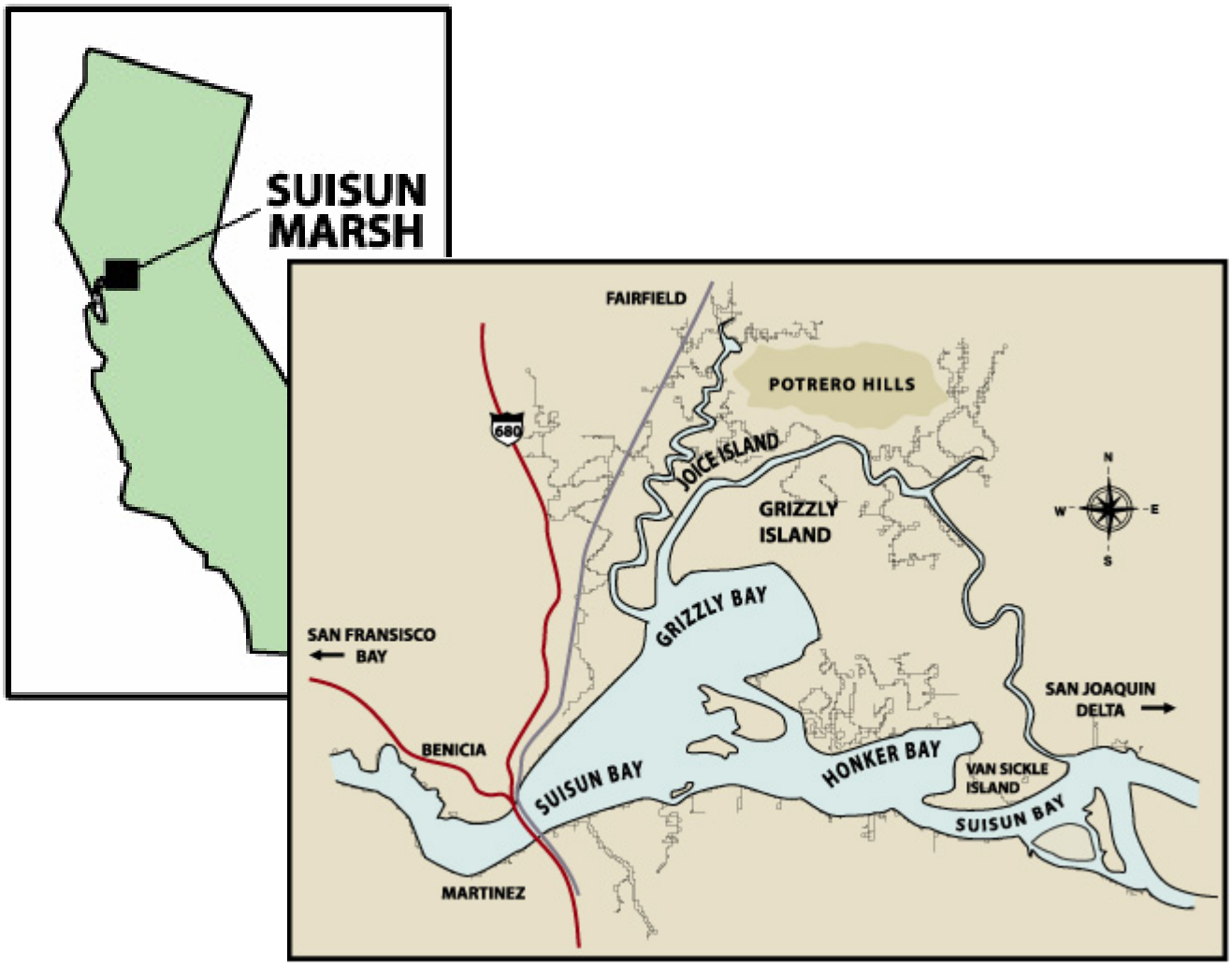

Figure 1- Location of the Suisun Marsh.

The DWR and the U.S. Bureau of Reclamation (USBR) store and divert water upstream of the Suisun Marsh. These and numerous other storage facilities and diversions can cause increased intrusion of saline water from San Francisco Bay to the Suisun Marsh and Delta during hydrologically dry periods.

The State Water Resources Control Board (SWRCB) adopted Water Rights Decision 1485 in 1978 to protect water quality in the Delta and the Suisun Marsh. This decision was recently superceded by SWRCB Decision 1641, which was adopted on December 29, 1999. Decision 1641 was subsequently amended and adopted as Order WR 2000-02 on March 15, 2000.

Several agreements have been developed between DWR, USBR, DFG, and Suisun Resource Conservation District (SRCD) to address SWRCB requirements for the protection of the Suisun Marsh. These agreements relate to monitoring salinity conditions in the Marsh, as well as monitoring impacts to wildlife and managed wetland operations. The agreements also cover the construction and operation of facilities for controlling salinity conditions in the marsh.

More detailed and specific background information on the Suisun Marsh and related monitoring programs is presented in the "Suisun Marsh Monitoring Program Reference Guide." This guide is accessible on the Internet at http://iep.water.ca.gov/suisun. A copy of the guide is also available on request from:

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Environmental Services Office
3251 S Street
Sacramento, CA 95816-7017
Attn: Ken Minn
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Data Summary

Hydrologic Conditions

Water Year Hydrologic Classification and Estimated Total Runoff for the Sacramento Valley

The Sacramento Valley Hydrologic Classification Index for water year 2000 is 8.93 million-acre feet (MAF). Water years with indices greater than 7.8 and less than 9.2 are considered "above normal years." The methodology for calculating the Index and the water year classification system for the Sacramento Valley are described in Appendix A. The 2000 Water Year Index calculation is included in Appendix B.

Estimated total runoff from the Sacramento Valley watershed for water year 2000 is 18.9 MAF. Table 2 lists water year classifications, estimated total runoff, and the water year Index for the Sacramento Valley for water years 1991 through 2000.

Table 2- Sacramento Valley Water Year Hydrologic Classification Data for 1991 through 2000.

Water Year	*Classification*[a]	*Index*[b]	*ETR*[c] *(maf)*
1991	Critical	4.2	8.4
1992	Critical	4.1	8.9
1993	Above normal [d]	8.5	22.4
1994	Critical	5.0	7.8
1995	Wet	12.7	33.9
1996	Wet	10.2	22.2
1997	Wet	10.8	25.4
1998	Wet	13.3	31.4
1999	Wet	9.75	21.0
2000	Above normal	8.93	18.9

[a] State Water Resources Control Board 1995 Water Quality Control Plan classification system.

[b] Sacramento Valley water year classification Index.

[c] Estimated total runoff using Sacramento Valley Four River Index in million acre-feet.

[d] Water year 1993 is classified as an above normal year instead of a wet year because it followed a critically dry year.

Monthly Mean Net Delta Outflow Index

The Net Delta Outflow Index (NDOI) is the estimated daily rate of outflow from the Delta calculated on a cubic foot per second (cfs) basis. Monthly mean NDOIs are calculated by averaging all daily NDOIs for a given month. The methodology for calculating the daily NDOI is described in Appendix C.

Large amounts of precipitation fell in the Sacramento River watershed during February and March of 2000. The monthly mean NDOI during water year 2000 peaked in March at 103,671 cfs, as listed in Table 3. With the exception of October through January, the monthly mean NDOIs for water year 2000 were similar to the values for water year 1999. The relatively low NDOI's for October through January of water year 2000, as compared to the same months in water year 1999, are likely a reflection of the "above normal" water year Index.

Table 3- Mean Monthly Net Delta Outflow for Water Years 1999 and 2000

	Net Delta Outflow Index (cubic feet per second)	
Month	*1999*	*2000*
October	12,267	4,263
November	20,481	6,904
December	47,052	10,811
January	36,373	19,933
February	105,173	97,823
March	73,633	103,671
April	35,004	28,554
May	22,911	23,449
June	14,052	9,907
July	10,817	9,827
August	6,141	6,507
September	4,754	4,921

Precipitation

Precipitation data are collected at DFG headquarters on Grizzly Island in the Suisun Marsh. Total monthly precipitation data for water year 2000 are listed in Table 4. As with water year 1999, February was the wettest month during water year 2000. Rainfall during this month accounted for nearly 38% of the total rainfall in the marsh during water year 2000.

Table 4- Total Monthly Precipitation at Grizzly Island for Water Year 2000.

Month	*Rainfall (inches)*	*Percent of Total Rainfall*
October	0.47	2.2
November	1.45	6.9
December	0.69	3.3
January	5.93	28.3
February	7.91	37.8
March	2.14	9.6
April	1.14	5.4
May	1.03	4.9
June	0.03	0.13
July	0.00	0.00
August	0.00	0.00
September	0.28	1.4
Total	20.95	100.00

Suisun Marsh Salinity Control Gates Operations

The operational status of the Suisun Marsh Salinity Control Gates (SMSCG) during Water Year 2000 is listed in Table 5. The purpose and operation of the SMSCG are described in Appendix D. During water year 2000, the gates were operated primarily for the purpose of conducting the "Evaluation of the Modification of the SMSCG on Adult Chinook Salmon Passage" study, as well as for salinity control. This study is further discussed in Appendix D.

Table 5- Suisun Marsh Salinity Control Gates Operational Schedule WY 2000

Period	*Operational status*[a]	*Flashboard status*
October 1, 1999 – October 14, 1999	Operational	In place
October 15, 1999 – November 9, 1999	Open, not operating	Out[b]
November 10, 1999 – December 9, 1999	Operational	In place[c]
December 10, 1999 – January 16, 2000	Open, not operating	In place[c]
January 17, 2000 – February 29, 2000	Operational	In place[c]
March 1, 2000 – March 27, 2000	Open, not operational	In place[c]
March 28, 2000 – September 30, 2000	Open, not operational	Out

[a] During water year 2000, the SMSCG were operated for the purpose of salinity control and for evaluating their effects on Chinook salmon passage.

[b] Flashboards out for spacer modification.

[c] Modified flashboards installed.

Water Quality Conditions

All SWRCB channel water salinity standards for the Suisun Marsh were met in water year 2000, as shown in Table 6. The locations of the five compliance stations and two monitoring stations are illustrated in Figure 2. A detailed discussion of the data collection methods is available in the *Suisun Marsh Monitoring Program Reference Guide, Version 1* cited in the "Background" section.

Suisun Marsh channel water salinity standards for water year 2000 are specified by SWRCB Order WR 2000-02 and are expressed in terms of specific electrical conductance (SC). Salinity conditions in the marsh are monitored by measuring SC levels. Additional information on the Suisun Marsh channel water standards for water year 2000 is presented in Appendix E (page 25).

Suisun Marsh channel water salinity conditions during water year 2000 were primarily a function of high Delta outflow. Monthly mean high-tide SC levels were markedly higher at the beginning of the 2000 water year compliance season (October 1999 through May 2000). SC levels began to drop dramatically at the end of January and continued at those low levels until the beginning of April, where levels, again, began to climb. Heavy precipitation commencing in late January and increased Delta outflow likely contributed to the decline in SC throughout the Marsh, as illustrated by Figures 3 through 5. During the 2000 compliance season monthly mean high tide SC at all compliance stations remained below SWRCB standards.

Table 6- Monthly Progressive Cumulative Mean High Tide Specific Conductance (SC at Suisun Marsh Compliance Stations and SWRCB Standards (mS/cm).

Month	*Eastern Stations*[a]			*Western Stations*[a]		
	C-2	S-64	S-49	S-42	S-21	Standard[b]
October	9.1	8.6	10.5	12.00	13.60	19.00
November	8.29	9.25	12.02	12.60	14.30	15.50
December	4.32	6.33	8.38	9.77	10.34	15.50
January	4.26	6.14	8.83	9.84	10.52	12.50
February	0.20	0.20	.090	1.90	1.90	8.00
March	0.20	0.50	0.90	1.30	1.20	8.00
April	0.20	1.60	2.30	2.60	2.60	11.00
May	0.20	0.80	1.80	1.80	1.60	11.00

[a] Note that some of the above values are calculated with missing data. See the graphs for details.

[b] Specified by SWRCB D-1641.

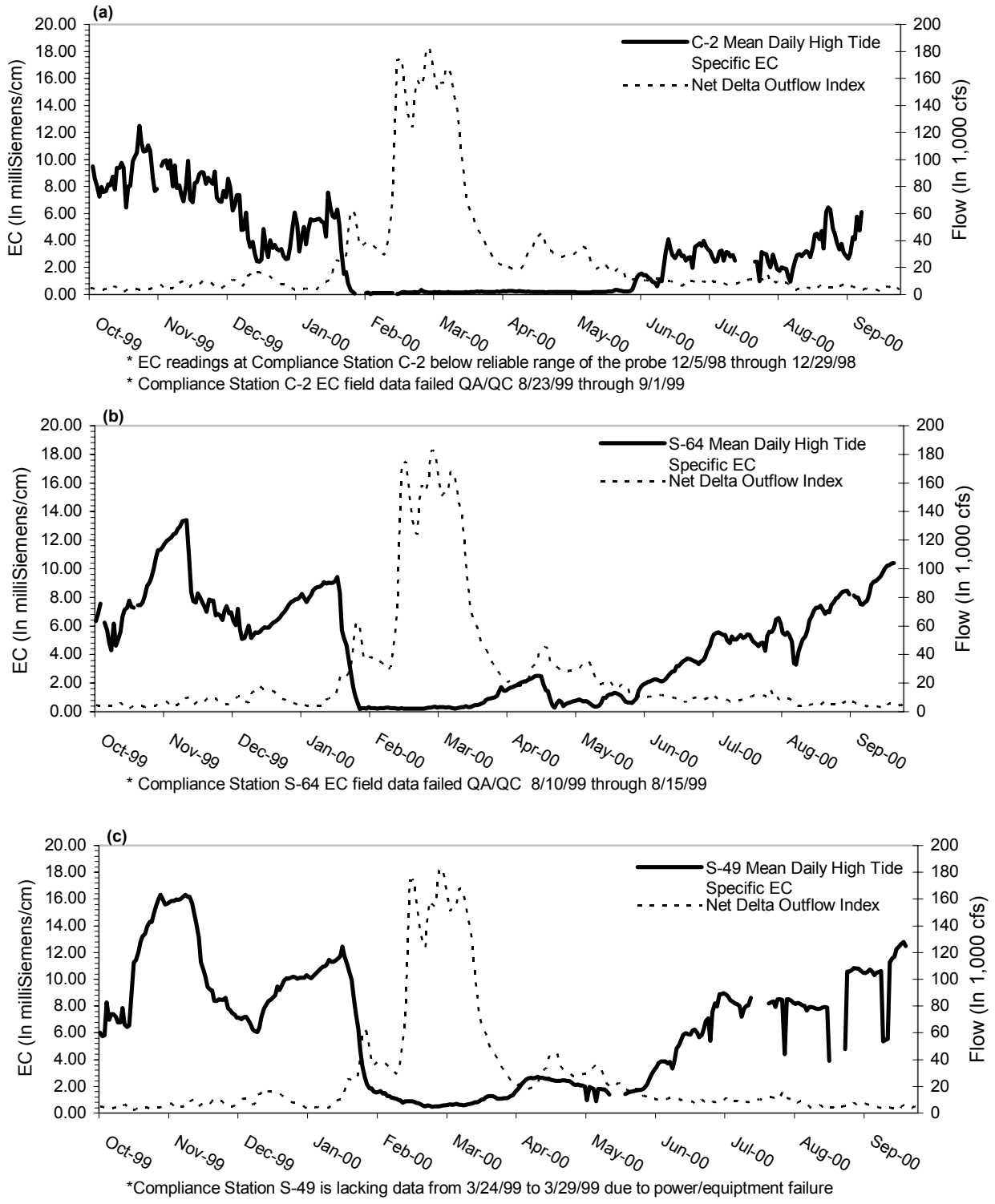

Figure 2 Specific electrical conductance and net delta outflow for water year 2000 at compliance stations (a) C-2, (b) S-64, and (c) S-49

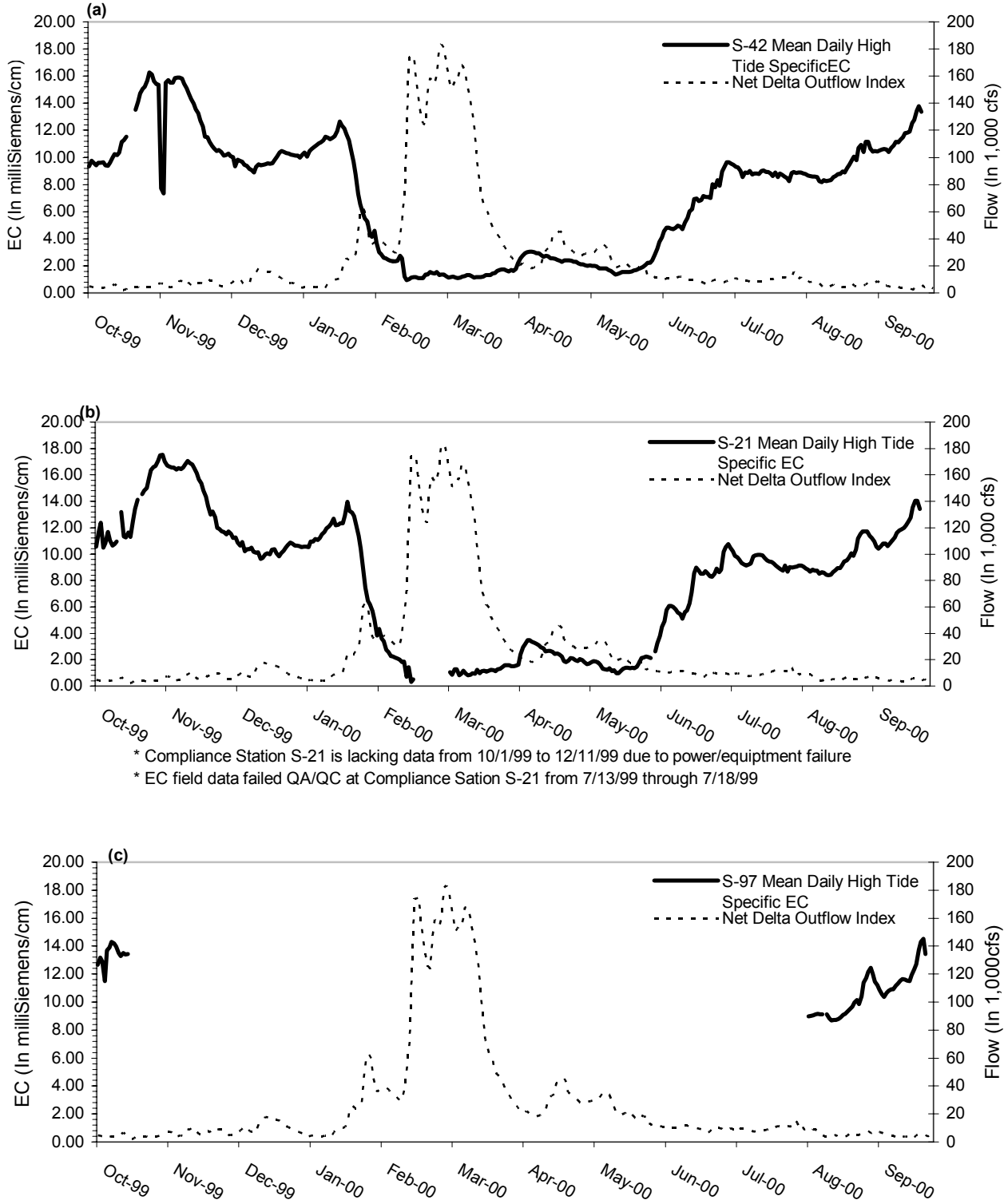

Figure 3 Specific electrical conductance and net delta outflow for water year 2000 at compliance stations (a) S-42, (b) S-21, and monitoring station (c) S-97

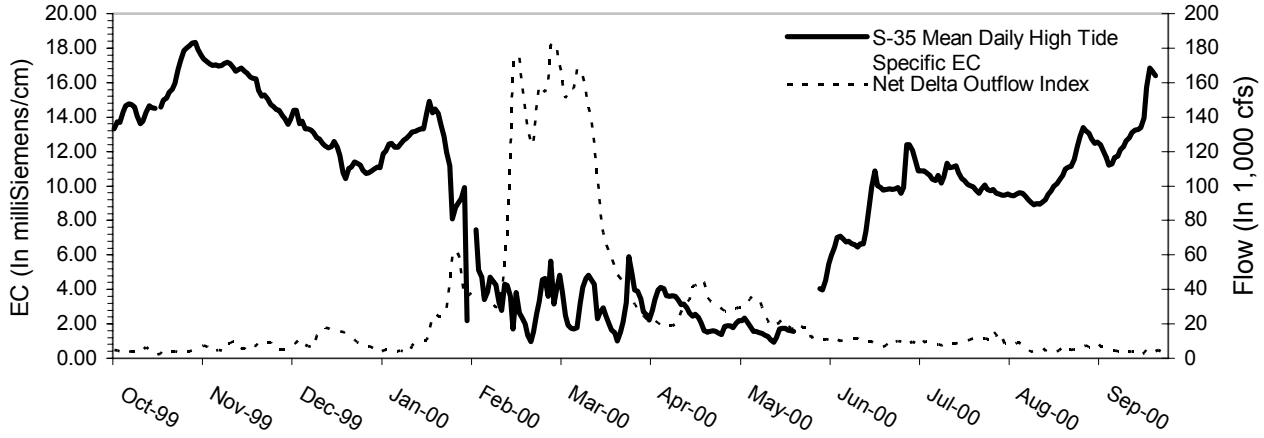

Figure 4 Specific electrical conductance and net delta outflow for water year 2000 at monitoring station S-35

Monthly mean high-tide channel water SC levels were lower at eastern marsh compliance stations than at western marsh compliance stations during most months of the 2000 water year compliance season. Eastern marsh stations are identified as those east of the confluence of Cutoff and Montezuma sloughs (S-64 and S-49) and those on the Sacramento River near the confluence with Montezuma Slough (C-2). Western marsh stations are those located west of the confluence of Cutoff and Montezuma sloughs (S-42 and S-21).

Salinity levels in the eastern portion of the Suisun Marsh are typically lower than levels in the western marsh largely because of the proximity of the eastern marsh to the Sacramento River and Delta. The station closest to the Delta, C-2, had the lowest monthly mean high tide salinity levels throughout the compliance season. Monthly mean high tide salinity levels at S-49, the westernmost of the eastern marsh stations, were consistently higher than those recorded at either C-2 or S-64. All compliance stations in the marsh followed the same SC pattern with the slight exception of C-2, its close proximity to the Delta likely contributing to the more erratic nature of the curve.

Table 7 shows monthly progressive cumulative mean high tide SC f data for monitoring stations S-35 and S-97. Comparison of the monitoring stations and compliance stations (Table 6) SC data shows the monitoring stations generally had higher SC than the five compliance stations. This was probably because this western marsh monitoring station S-35 lies relatively close to Suisun Bay where influence from Delta outflow is low.

Table 7- Monthly Progressive Cumulative Mean Specific Conductance (SC) at High Tide at Suisun Marsh Monitoring Stations (mS/cm).

Month	*S-97*	*S-35*
October	13.57[a]	15.57
November		15.92
December		12.07
January		12.05[b]
February		3.57[b]
March		3.10
April		2.62
May		1.75[b]

[a] Monitoring station S-97, was inoperable for the majority of the 2000 water year and all of the control season due to the replacement of the stage recording device (*see Monitoring Station Maintenance*).

[b] Lacking data on 1/31/00-2/1/00 and 5/23/00-5/30/00 due to power/equipment failure.

Wildlife

Salt Marsh Harvest Mouse (SMHM) Monitoring

In water year 2000, a total of ten areas in the Suisun Marsh were surveyed for presence of SMHM. The areas surveyed included five existing SMHM Conservation Areas, two sites proposed as new SMHM Conservation Areas (Goodyear and Hill Slough Area 9), two SMHM mitigation areas (Island Slough ponds 4 and 7), and one upland area owned by Solano County Open Space Foundation (Rush Ranch) (Figure 5). Conservation Areas are DFG lands that are managed as habitat for the SMHM as mitigation for impacts of DWR facilities and activities in Suisun Marsh. The primary goal of the surveys was to determine if SMHM were present at each site, and to generally assess population levels. The goal of the survey at the upland area was to collect western harvest mice (WHM, *Reithrodontomys megalotis*) specimens for a harvest mouse genetics study. Results of the surveys are summarized in Table 8.

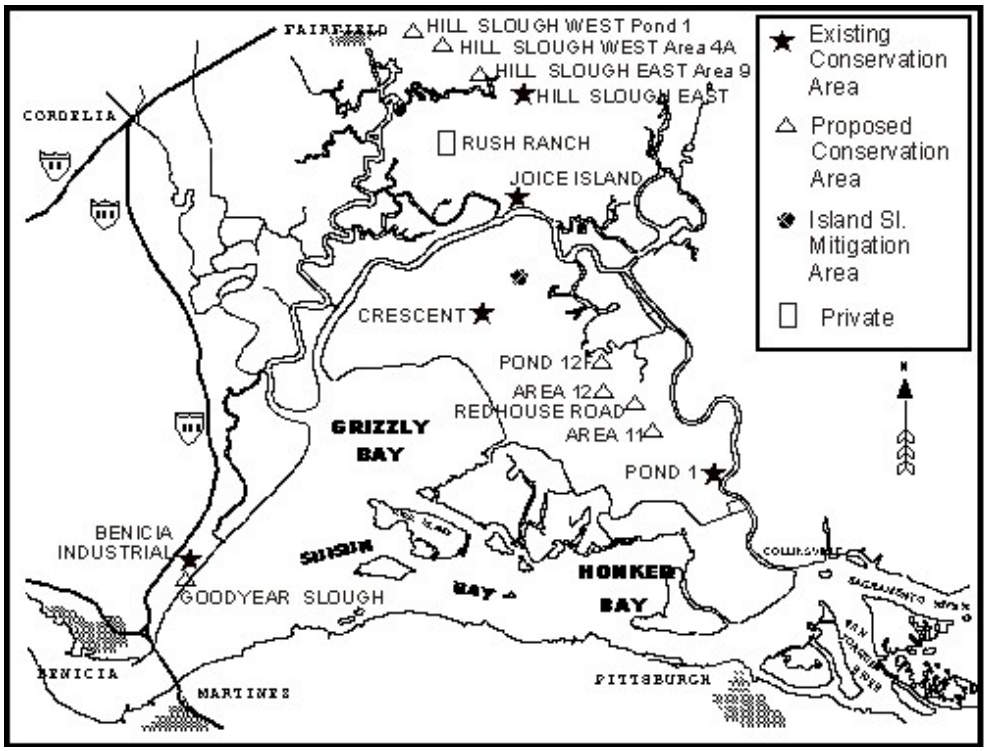

Figure 5- Areas of Suisun Marsh surveyed for presence of salt marsh harvest mouse during water year 2000.

Table 8- Results of 2000 Salt Marsh Harvest Mouse Surveys in Suisun Marsh.

Site	dates surveyed	# trap nights[1]	Results[2]					
			SMHM[3]	UNHM[4]	WHM[5]	Microtus[6]	Mus[7]	Other
Pond 15	6/20-6/23/00, 6/26-6/28/00	700	40+46	10+22		164	14	
Benicia	7/12-7/14 and 7/17/00	400	21+10			18	48	1Rattus (rat)
Goodyear	7/11-7/14/00 and 7/17/00	500	20 + 13	3		38		2 Sorex (shrew)
Crescent	7/24-7/27/00	400	35 + 29	4 + 1		49	3	
Pond 1	7/24-7/27/00	400	3+2					
Island Sl. Pond 7	8/7-8/10/00	400		1+1		22	28	4 Rattus
Island Sl. Pond 4	8/7-8/10/00	400	4+3	1			2	
Rush Ranch	8/17-8/18/00	200			5		1	
Hill Sl. Area 9	8/21-8/24/00	400	15+5	15+3	4	4	8	
Peytonia Slough	8/22-8/25/00	400	12+5	2		8	5	

1. One trap night=one trap set for one night
2. Numbers listed for harvest mice are number of individuals captured + number of recaptures. Numbers of other species include all recaptures.
3. SMHM=salt marsh harvest mouse, *Reithrodontomys raviventris halicoetes*
4. UNHM=unknown harvest mouse—characteristics were intermediate between those of salt marsh and western harvest mice.
5. WHM=western harvest mouse, *Reithrodontomys megalotis*
6. Microtus=*Microtus californicus*, meadow vole
7. Mus=*Mus musculus*, house mouse

Detailed discussion of the trapping and identification methods can be found in Appendix F.

Some harvest mice have characteristics intermediate between those typical of either salt marsh or western harvest mice. Harvest mice with ambiguous or intermediate characteristics were classified as "unknown harvest mice". These unknown harvest mice raised questions about the genetics of harvest mice in Suisun Marsh and the applicability of the standard protocols and interest was generated in conducting a study of harvest mouse genetics in the Suisun Marsh. In 2000, with recommendations from the DFG and other participants of the Suisun Marsh Environmental Coordination Advisory Team (ECAT), DWR agreed to fund a SMHM genetics study proposed by Dr. Francis Villablanca of California Polytechnic State University at San Luis Obispo. The study has three objectives: (1) identification of species-specific genetic markers and matching the markers to morphological characteristics, (2) test for hybridization between SMHM and WHM, and (3) test for genetic differentiation between populations from different areas around the San Francisco Bay estuary.

Waterfowl

The DFG conducted aerial waterfowl counts in the Suisun Marsh monthly from September 1999 through January 2000. Appendix G contains a discussion of the data collection method. The results of the surveys are shown in Table 2. Summarized census estimates are included for northern pintail, mallards, all ducks combined, and all waterfowl combined. Northern pintail and mallards are the most common waterfowl species found in Suisun Marsh, and thus are listed separately as indicators of overall relative waterfowl abundance. Ten-year averages (1990-1999) are shown in Table 2 to compare Water Year 2000 totals with recent averages. Observed numbers of ducks and waterfowl in the marsh were close to or higher than the 1990-1999 ten-year averages in all months but October.

Table 9- Waterfowl Counted in Suisun Marsh During Monthly Aerial Surveys, Water Year 2000 and Average Numbers Counted from Water Year 1990 through 1999.

Month	Mallard	Northern Pintail	Total Ducks[1]	Total Waterfowl[2]
Numbers Observed During Monthly Surveys, Water Year 2000				
September	6,350	7,735	19,057	22,172
October	8,855	22,797	48,327	54,782
November	12,655	31,210	96,670	109,948
December	26,635	57,610	163,746	176,956
January	12,215	45,790	122,015	131,238
Average Numbers Observed During Monthly Surveys, Water Years 1990 - 1999				
September	5,040	6,500	16,490	17,200
October	16,880	32,210	77,520	84,790
November[3]	12,910	32,530	88,480	96,510
December[3]	14,360	34,730	119,680	130,410
January	10,470	20,860	79,820	88,640

1/ Includes all species of ducks observed during monthly surveys.
2/ Includes all species of ducks, geese, swans, and coots observed during monthly surveys.
3/ November and December averages are only 9-year averages.

Vegetation

During water year 2000, work continued on a new vegetation map for Suisun Marsh. A new vegetation mapping methodology developed by DFG was approved by the ECAT in water year 1999. The new methodology is designed to document changes in preferred habitat for the salt marsh harvest mouse, and gather vegetation data in such a way that it can be used for a variety of other purposes. The methodology follows a standardized protocol used by the National Park Service and U.S. Geological Survey. The methodology is described in "The Vegetation Survey for the Suisun Marsh, A New Methodology**".**

DFG staff continued vegetation sampling at randomly selected vegetation plots throughout the marsh. Field sampling data was entered into a database and vegetation classification codes were developed. DFG continued photo interpretation and GIS scanning and registration. The target completion date for the vegetation map is November 2001.

Maintenance

Monitoring Station Maintenance

Routine monitoring station maintenance in the Suisun Marsh during water year 2000 included flushing accumulated sediments from several tide and stage wells, clearing accumulated vegetation around monitoring stations, and performing level surveys for staff gage checks / resets and water stage elevations. EC probes that were shown to have a reduction in accuracy were either replatinized or replaced.

Other station maintenance activities included reconstructing the walkway and railings at Cygnus (S-33) and installing a new walkway ramp at Beldon's Landing (S-49). Ibis (S-97) was completely remodeled to overhaul outdated equipment, resulting in the removal of the tide well and installation of a pressure transducer. Dam construction by an industrious beaver restricted flow in Green Valley Creek, which requiredrelocation of S-10 1/3 mi. upstream at Mangels Road.

A new dimple collar was installed around the stilling well at Collinsville (C-2) to help suppress wave action coming through holes in the well. Due to the tidewell's rapid corrosion and because of possible changes the landowner (*Levine-Frickle Restoration*) may make in the immediate area, plans were made to share the newly restored USBR station located, approximately 1/3 mi. upstream, at the end of Collinsville Road. Relocation of the station is expected to occur in September 2001.

Distribution System Maintenance

During water year 2000, DWR's Delta Field Division performed routine maintenance on all Initial Facilities.

References

State Water Resources Control Board. 1999. Water Right Decision 1641 Implementation of Water Quality Objectives for the San Francisco Bay/Sacramento San Joaquin Delta Estuary. Sacramento (CA): State Water Resources Control Board. __p.

[SWRCB] 2000. Order WR 2000-02. Sacramento (CA): State Water Resources Control Board. 36 p.

Appendix A

Methodology for Determining Water Year Hydrologic Classification for the Sacramento Valley

The water year hydrologic classification for the Sacramento Valley was determined following the methodology outlined in the SWRCB "Water Right Decision 1641 Implementation of Water Quality Objectives for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 1999)). The Index for the Sacramento Valley is calculated as follows:

INDEX = 0.4*X + 0.3*Y + 0.3*Z

Where:

X = Subject year's April – July Sacramento Valley unimpaired runoff;
Y = Subject year's October – March Sacramento Valley unimpaired runoff
Z = Previous year's index[1]

Sacramento Valley unimpaired runoff is defined in the SWRCB plan as follows:

> The Sacramento Valley unimpaired runoff for the current water year (October 1 of the preceding calendar year through September 30 of the current calendar year), as published in California Department of Water Resources Bulletin 120, is a forecast of the sum of the following locations: Sacramento River above Bend Bridge, near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River at Smartville; American River, total inflow to Folsom Reservoir

The year type is determined based on the Index value, as shown in Table A-1. The year type for the preceding water year remains in effect until the initial forecast of unimpaired runoff for the current water year is available.

Table A-1- Determination of Year Type Based on Index Value.

Classification	*Runoff Index (million acre-feet)*
Wet	Equal or greater than 9.2
Above Normal	Greater than 7.8 and less than 9.2
Below Normal	Equal to or less than 7.8 and greater than 6.5
Dry	Equal to or less than 6.5 and greater than 5.4
Critical	Equal to or less than 5.4

[1] A cap of 10.0 MAF is put on the previous year's index (Z) to account for required flood control reservoir releases during wet years.

Appendix B

Sacramento Valley Water Year 2000 Hydrologic Classification

The following equation was used to calculate the Sacramento Valley Hydrologic Classification for water year 2000:

$$\text{Index} = 0.4X + 0.3Y + 0.3Z$$

where:

Index = Index for water year 2000 (MAF)

X = April 2000 – July 2000 Sacramento Valley unimpaired runoff (MAF).

Y = October 1999 - March 2000 Sacramento Valley unimpaired runoff (MAF).

Z = Previous water year's Index (maximum allowable value for Z is 10.0 MAF).

The calculation for water year 2000 is:

$$X = 5.96 \text{ MAF}$$
$$Y = 12.06 \text{ MAF}$$
$$Z = 9.75 \text{ MAF}$$

$$\text{Index} = 0.4(5.96 \text{ MAF}) + 0.3(12.06 \text{ MAF}) + 0.3(9.75 \text{ MAF}) = 8.93 \text{ MAF}$$

Based on an Index value of 8.93 MAF, water year 2000 is classified as an Above Normal year.

Appendix C
Methodology for Calculating the Net Daily Outflow Index

The NDOI was determined following the methodology in the SWRCB "Water Right Decision 1641 Implementation of Water Quality Objectives for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 1999). The NDOI is computed daily using the following formulas (all flows are in cfs):

NDOI = DELTA INFLOW – NET DELTA CONSUMPTIVE USE – DELTA EXPORTS

Where DELTA INFLOW = SAC + SRTP + YOLO + EAST + MISC + SJR

SAC = Sacramento River at Freeport mean daily flow for the previous day; the 25-hour tidal cycle measurements from 12:00 midnight to 1:00 a.m. may be used instead.
SRTP = Sacramento Regional Treatment Plant average daily discharge for the previous week.
YOLO = Yolo Bypass mean daily flow for the previous day, which is equal to the flows from the Sacramento Weir, Fremont Weir, Cache Creek and Rumsey, and the South Fork of Putah Creek.
EAST = Eastside Streams mean daily flow for the previous day from the Mokelumne River at Woodbridge, Cosumnes River at Michigan Bar, and Calaveras River at Bellota.
MISC = Combined mean daily flow for the previous day of Bear Creek, Dry Creek, Stockton Diverting Canal, French Camp Slough, Marsh Creek, and Morrison Creek.
SJR = San Joaquin River flow at Vernalis, mean daily flow for the previous day.

Where NET DELTA CONSUMPTIVE USE = GDELP – PREC

GDELP = Delta gross channel depletion for the previous day based on water year type using the DWR's latest Delta land use study.[1]
PREC = Real-time Delta precipitation runoff for the previous day estimated from stations within the Delta.

and where DELTA EXPORTS[2] = CCF + TPP + CCC + NBA

[1] The DWR is currently developing new channel depletion estimates. If these new estimates are not available, DAYFLOW channel depletion estimates shall be used.
[2] The term "Delta Exports" is used only to calculate the NDOI. It is not intended to distinguish among the listed diversions with respect to eligibility for protection under the area of origin provisions of the California Water Code.

CCF = Clifton Court Forebay inflow for the current day.[3]
TPP = Tracy Pumping Plant pumping for the current day.
CCC = Contra Costa Canal pumping for the current day.
NBA = North Bay Aqueduct pumping for the current day.

[3] Actual Byron-Bethany Irrigation District withdrawals from Clifton Court Forebay shall be subtracted from Clifton Court Forebay inflow. (Byron-Bethany Irrigation District water use is incorporated into the GDEPL term.)

Appendix D

Purpose and Operation of the Suisun Marsh Salinity Control Gates

The SMSCG were completed and began operating in October 1988. The first year of operation was used to test the gates, and official operation began in November 1989.

The facility consists of a boat lock, a series of three radial gates, and flashboards. The gates control salinity by closing during incoming tides to restrict the flow of higher salinity water from Grizzly Bay into Montezuma Slough. The gates open during outgoing tides to allow fresher water to enter Montezuma Slough and the marsh from the Sacramento and San Joaquin Rivers. Operation of the gates in this fashion lowers salinity in Suisun Marsh channels and results in a net movement of water in Montezuma Slough from east to west (downstream). When Delta outflow is low to moderate and the gates are not operating, net water movement in Montezuma Slough is from west to east, resulting in higher salinity water in Montezuma Slough.

The SMSCG may begin operating in September to help meet salinity standards, and may continue operating through the end of May, depending on salinity conditions. The flashboards are removed and the gates raised to allow unrestricted movement through Montezuma Slough when the channel water salinity decreases sufficiently below the salinity standards, or at the end of the control season.

A DWR study evaluating the effects of the SMSCG on passage of chinook salmon was continued during water year 2000. The effect of various modified flashboard configurations on salmon passage was evaluated. The gates were operated for the purpose of the study and for salinity control during water year 2000. Additional information on the salmon passage study is available from:

California Department of Water Resources
Environmental Services Office
3251 S Street
Sacramento, CA 95816-7017
Attn: Heidi Rooks
(916) 227-2557
hrooks@water.ca.gov

Appendix E

Suisun Marsh Channel Water Salinity Standards for Water Year 2000

Compliance Stations and Monitoring Stations

Suisun Marsh channel water salinity standards for Water Year 2000 are specified by SWRCB Order WR 2000-02 (SWRCB2000). The SWRCB granted a waiver (Order WR 98-6, September 17, 1998) for meeting Suisun Marsh channel water salinity standards during water year 2000 at the five compliance stations (Table E-1). The waiver was granted for the purpose of conducting an experiment to evaluate the effect of modified flashboard configurations on salmon passage at the SMSCG.

Two salinity monitoring stations, S-35 and S-97, did not have SWRCB salinity standards in effect during water year 2000. The names and locations of these two monitoring stations are listed in Table E-1.

Data from monitoring stations S-35 and S-97 have been included in this report to provide additional information on salinity conditions in the western portion of the Suisun Marsh during water year 2000. Data from the eleven other water-quality monitoring stations in the Marsh were not included in this report, but are available on request by contacting the address referenced in the Background section of this report (page_).

Table E-1. Suisun Marsh Salinity Compliance and Monitoring Stations

Station Identification	*Station Name*	*General Location*
Compliance Stations		
C-2	Collinsville	Western Delta
S-64	National Steel	Eastern Suisun Marsh
S-49	Beldon's Landing	North-central Suisun Marsh
S-42	Volanti	Northwestern Suisun Marsh
S-21	Sunrise	Northwestern Suisun Marsh
Monitoring Stations		
S-35	Morrow Island	Southwestern Suisun Marsh
S-97	Ibis	Western Suisun Marsh

Appendix F

Salt Marsh Harvest Mouse Monitoring in the Suisun Marsh

Background

The salt marsh harvest mouse (SMHM, *Reithrodontomys raviventris*) is endemic to Suisun Marsh and other marshes of the San Francisco Bay estuary. The species was listed as endangered by the USFWS in 1970 and by DFG in 1971. Surveys are conducted annually in the Suisun Marsh to assess SMHM use of areas that are managed as SMHM habitat. The surveys summarized in this report were conducted cooperatively by the DFG and the DWR. These endangered species surveys are permitted under a Memorandum of Understanding (MOU) between the DFG and the USFWS (USFWS Permit No. TE835365-1 to DWR), and a MOU between DWR and DFG.

In 1981 the USFWS issued a Section 7 Biological Opinion (Opinion) for the implementation of the Suisun Marsh Plan of Protection which required DFG (on behalf of DWR) to manage 1,000 acres as SMHM habitat (called Conservation Areas), and to preserve a total of 2,500 acres of preferred SMHM habitat throughout the marsh. Seven Conservation Areas totaling 1,130 acres were established in 1987. Since 1998, the Suisun Marsh ECAT has been working with the USFWS to determine which areas of the marsh to include in the 2,500 acres of preserved SMHM habitat. In 1999, the 253-acre Peytonia Slough Ecological Reserve was accepted by USFWS as a Conservation Area, and in 2000 six additional parcels were being considered as Conservation Areas. The eight Conservation Areas total 1,382 acres. In addition, there are two parcels at Island Slough which are managed as SMHM habitat as mitigation for DWR projects in the marsh.

Methodology

For the annual surveys of the Conservation and mitigation areas, one hundred Sherman live-traps were placed at each area and set for four consecutive nights. Traps were placed at 10-meter intervals. Traps were opened within one hour of sunset and checked the next morning within 90 minutes of sunrise. Traps were baited with a mixture of commercial birdseed and ground walnuts, and cotton batting was provided as bedding material. Traps were usually placed in areas with a high percentage of vigorous pickleweed (*Salicornia virginica*) with little bare ground.

Identification of harvest mice to species level was done according to protocols established by Shellhammer (1984), which are based primarily on tail/body ratio and four tail characteristics (tail diameter at 2.0 cm from the body, color of ventral and dorsal tail hairs, and shape of tail tip). In Suisun Marsh, SMHM typically

have tail/body ratios greater than 114% and tail diameters greater than 2.0 mm, while the co-occurring and similar-looking western harvest mouse (WHM, *Reithrodontomys megalotis*) typically has a tail/body ratio less than 114% and tail diameter less than 2.0 mm (Fisler 1965, Figure 5; Shellhammer 1984, pp. 118, 119). The four tail characteristics are each given a value from 0-2, and the scores for each characteristic are added to give a total score. SMHM typically have scores of 0-3, while WHM usually score from 6-8. After field data were collected, all harvest mice (except escapees) were individually hair-clipped or ear-tagged to determine subsequent recaptures.

Harvest mice with characteristics intermediate between those typical of either SMHM or WHM were classified as "unknown harvest mice" (UNHM). Also included in the numbers of "unknowns" were juvenile harvest mice which were too small to use the morphometric system of identification and harvest mice that could not be identified to species because they escaped prior to data collection.

Harvest mouse genetics study

After the 1999 SMHM surveys found numerous harvest mice which could not be characterized as either SMHM or WHM using the standard protocols (Shellhammer 1984), interest was generated in conducting a study of harvest mouse genetics in the Suisun Marsh. In 2000, with recommendations from the Suisun Marsh Environmental Coordination Advisory Team, DWR agreed to fund a SMHM genetics study proposed by Dr. Francis Villablanca of Cal Poly SLO. The study has three objectives: (1) identify species-specific genetic markers of both WHM and SMHM and match the markers to morphological characteristics, (2) test for hybridization between SMHM and WHM, and (3) test for genetic differentiation between populations from different areas around the San Francisco Bay estuary.

During annual SMHM surveys in 1999 and 2000, hair samples were collected by pulling hair with tweezers from captured harvest mice. Samples were placed in vials and frozen to preserve the tissue. These samples, as well as tissue samples from trap mortalities were sent to Dr. Villablanca for genetic testing.

Appendix G

Waterfowl Surveys in the Suisun Marsh during Water Year 2000

Background

The Suisun Marsh is an important wintering area for waterfowl along the Pacific Flyway. Waterfowl commonly wintering in Suisun Marsh (DWR 1984) include:

- northern pintail (*Anas acuta*);
- mallard (*Anas platyrhynchos*);
- American wigeon (*Anas americana*);
- green-winged teal (*Anas crecca*);
- northern shoveler (*Anas clypeata*);
- ruddy duck (*Oxyura jamaicensis*);
- canvasback (*Aythya valisineria*);
- white-fronted goose (*Anser albifrons*); and,
- Canada goose (*Branta canadensis*).

Migrant waterfowl begin arriving in the Marsh each year during August. The highest waterfowl counts usually occur in October. Waterfowl numbers in the marsh typically remain fairly constant from October through December and then usually decline in January.

Data Collection Methods

The DFG conducted semi-monthly aerial waterfowl population surveys in the Suisun Marsh from September 1999 through January 2000. Census estimates (DFG unpublished data) were provided to DWR in digital and tabular form.

Waterfowl surveys in the Marsh were flown 100 to 150 feet above the ground at speeds of 90-105 miles per hour (USFWS 1987). Observers estimated the numbers and species composition of waterfowl within 1\8th mile of either side of the plane. Data reported were the total estimated numbers observed during the survey. Short-term factors such as weather and movements by waterfowl flocks in addition to longer-term factors, such as land use changes, preclude use of annual census results for determining absolute population size. The aerial survey results are generally useful for identifying long-term trends in approximate numbers of waterfowl in the Marsh.